

Research Article – Basic and applied anatomy

Thymic artery: uncommon origin from proximal aortic arch or distal ascending aorta

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Abstract

Internal thoracic and inferior thyroid arteries mainly supply the thymus. However, very few studies have been reported on the arterial variations of the thymus. The first author, a cardiac surgeon, happened upon a thymic artery arising from either proximal aortic arch or distal ascending aorta in a few cases during routine cardiac surgery in infants and neonates. Hence a study on the prevalence of the variant thymic artery during open heart surgery was contemplated, as knowledge of its presence could avoid its injury during surgical and diagnostic procedures of the region.

The prevalence of the variant thymic artery was observed during 100 consecutive cardiac surgeries in infants and neonates. In addition to two branches from internal thoracic and inferior thyroid arteries, a thymic artery originating from the distal ascending aorta or proximal arch was found in 15 (15%) out of 100 patients who underwent open heart surgery for the correction of congenital heart defects. The artery took origin from the anterior surface of aorta, a little to the left. These were small arteries, single in origin, which started at right angles from the aorta and pierced the pericardium at its reflection, from visceral to parietal, to reach the posterior surface of the thymus where they divided into two branches, one for each lobe.

Since this variant artery was present in 15% cases, being aware of its presence can help prevent troublesome bleeding during surgical thymectomy, and more importantly, during surgical and diagnostic interventions in the mediastinum.

Key words

Neonatal thymus, Aortic arch, Middle thymic artery, Arterial variations

Introduction

The thymus, one of the two primary lymphoid organs (the other being bone marrow), is an encapsulated bilobed organ, the two lobes being joined in the midline by connective tissue that blends with the capsule of each lobe. (Standring, 2008a). It is supplied mainly by branches of the internal thoracic and inferior thyroid arteries, which also supply the surrounding connective tissue in the mediastinum. Occasionally there may be a branch from the superior thyroid artery. The thymus does not have a hilum, but internal branches pass directly through the capsule and then frequently

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into the interior of the interlobar septae before entering the thymus at the junction of the cortex and medulla (Strandring, 2008a).

Very few studies have been reported on the variations in the blood supply of thymus. However this is not a planned study. The first author, a cardiac surgeon, happened to notice the origin of a thymic artery from an uncommon source, i.e., either distal ascending aorta or proximal aortic arch during routine cardiac surgery in infants and neonates. Since he came across such a variant artery in quite a few cases, a study on the prevalence of this supplementary variant artery was contemplated, as knowledge of its presence may allow to avoid troublesome bleeding during surgical thymectomy and, more important, its injury during surgical and diagnostic procedures of the region.

Materials and Methods

The prevalence of a thymic artery arising from either the distal ascending aorta or proximal aortic arch was observed in 100 subjects, all of whom were infants or neonates undergoing cardiac surgery for the correction of congenital heart defects (CHDs) in the Department of Cardiovascular and Thoracic Surgery, Amrita School of Medicine, Kochi, Kerala, India. The observations were made on 100 consecutive surgeries.

Observations

Out of the 100 surgeries performed on infants and neonates, in 15 cases (15%), in addition to the two branches from internal thoracic and two from the inferior thyroid arteries, a thymic artery was found arising from either the distal part of ascending aorta or from the proximal part of aortic arch. This artery can aptly be called "middle thymic artery" (Fig. 1). The said artery took origin from the anterior surface of the aorta, a little to the left. It was a small artery of slightly variable size that pierced the pericardium at its reflection (from visceral to parietal) on the aorta. The artery was single at its origin and divided on the posterior aspect of the thymus to form two branches, one for each lobe (Fig. 2). We have not observed any consistent correlation between the presence of the artery and specific CHDs, but it appears to be more frequent in cyanotic cases and this deserves further investigation. No other variations were observed in the structural or arterial pattern of thymus.

Discussion

In the present study, the origin of the variant thymic artery was observed in 100 consecutive CHD surgeries in infants and neonates. In 15% cases, a thymic artery was found arising from distal ascending or proximal aortic arch. Few studies have been reported on the variations in the blood supply of thymus in man. In one study (Bell et al., 1954), in 77 subjects, it was noted that the thymus was supplied by internal thoracic artery in 59 cases, pericardio-phrenic artery in 13, inferior thyroid artery in

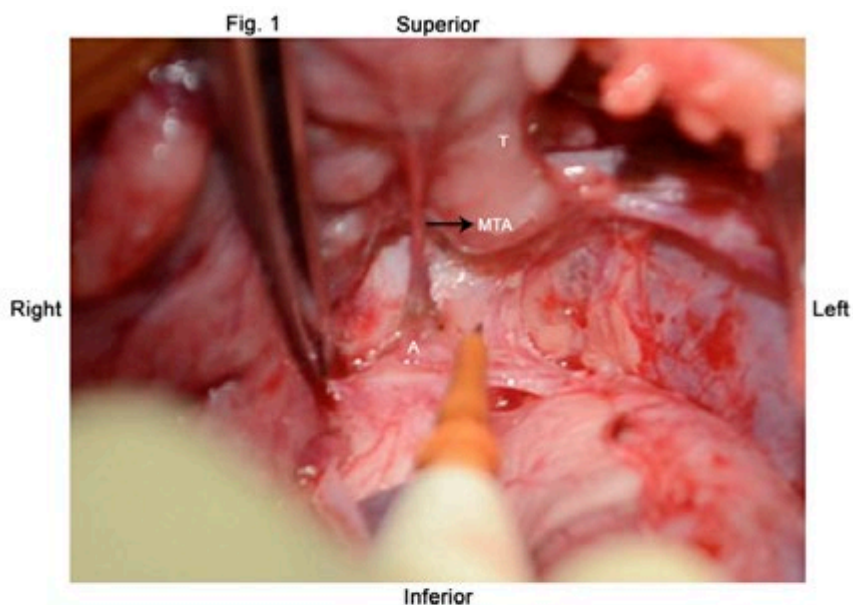


Figure 1 – Middle thymic artery arising from the aorta. Intraoperative aspect. T: thymus. A: aorta. MTA: middle thymic artery.

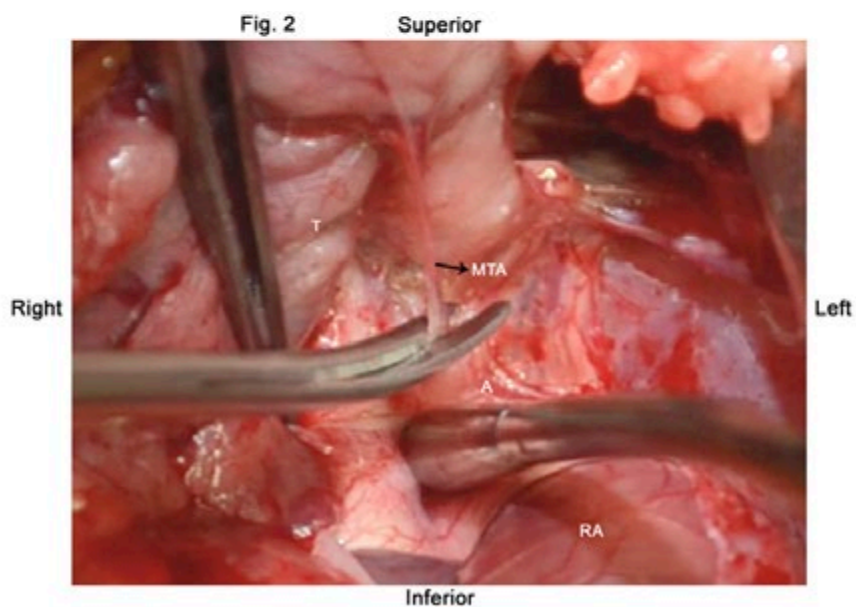


Figure 2 – Middle thymic artery dividing into 2 branches for the two lobes of the thymus. Intraoperative aspect. T: thymus. A: aorta. MTA: middle thymic artery. RA: right auricle.

6, and brachiocephalic trunk in 2 cases. Another study reported that among various arteries the middle thyrothyroid artery showed the highest frequency: 44% in foetuses and 27.3% in adults. In this study, the superior thymic artery was also frequent, being 33.7% in foetuses and 18.8% in adults, as also the middle thymic artery which occurred in 32.6% and 14.3% of foetuses and adults respectively (Yamasaki, 1989a). A thymic artery arising from superior thyroid artery was also reported by the same author in four cases, one in adult and three in foetuses, among 77 adult cadavers and 45 foetuses (Yamasaki, 1989b). The author suggested that this artery be called supreme thymic artery or '*arteria thymica suprema*' because of its location and anatomical significance (Yamasaki, 1989b).

In another study on thymic arteries (Yamasaki, 1990), in 50 male and 50 female rats, the thoracic lobes of the thymus were supplied by a branch of internal thoracic artery, or indirectly by a branch of pericardio-phrenic artery, in all the cases; more than half of the specimens had a cervical thymic lobe of variable size which was supplied by a branch of cranial thyroid, external carotid or occipital arteries. It was concluded that thymic arteries of rats are basically similar to those of man. Ghanbari et al. (2010) reported a rare case of a 65 year old man where the thymic artery was found arising from a common trunk with thyroidea ima artery from the brachiocephalic trunk. After a short course, the common trunk divided into an ascending thyroidea ima artery and a descending thymic branch. The thymic artery continued its downward course for about 3 cm and ended as two branches in the right and left lobes of the thymus. Though Bergman et al., (2014) in the *Illustrated Encyclopaedia of Human Anatomical Variations* mentions that thymic artery may arise from ascending aorta or aortic arch, our literature search did not reveal any study or case report with similar variations other than that by Yamasaki (1989a).

According to Yamasaki, (1995), some of the anomalous arteries of the thyroid and thymus may be vestiges of earlier arterial component of both organs, or may express some transitional stage from the earlier embryological arterial pattern to the stable final condition. The thymus develops from pharyngeal pouches neighbouring the thyroid anlage, which may be the reason why the thymus is supplied by arteries of the thyroid. It is more commonly supplied by inferior thyroid by virtue of its position. The thymic gland is formed from the ventral part of the third pharyngeal pouch on each side. It descends into the anterior mediastinum once the neck is fully developed and the heart has descended (Standring, 2008b). This explains the blood supply by the anterior mediastinal branches of internal thoracic or by pericardio-phrenic arteries. In the present study, the thymic artery was observed arising from the distal ascending or proximal aortic arch. Following the differentiation of inferior parathyroid glands, the thymus is represented by two elongated diverticula, which subsequently become solid cellular masses that grow caudally into the surrounding cardiac neural crest mesenchyme (Standring, 2008b). The two thymic rudiments meet ventral to the aortic sac but do not fuse, and are subsequently joined by connective tissue (Standring, 2008b). This proximity to the aortic sac during development could be the reason why the thymic artery was found arising from the proximal part of aortic arch, as the proximal segment of aortic arch develops from the aortic sac (Saddler, 2012). The origin of thymic artery from the ascending aorta can be explained from the fact that the ascending aorta develops from the ventral part of truncus arteriosus, and the aortic sac becomes the most distal part of truncus arteriosus (Saddler, 2012).

Conclusion

A variation in the arterial supply of the thymus in neonates and infants is presented here. In addition to the two branches from the internal thoracic and two from the inferior thyroid arteries, there is one common variant from the aorta. Since this variation was present in 15% of the cases, being aware of its presence could avoid troublesome bleeding during surgical thymectomy. More important, the variant artery is vulnerable to accidental injury and bleeding during surgical and diagnostic procedures such as thoracoscopic thymectomy or mediastinoscopy/mediastinal biopsy. In open surgery, control of bleeding is more at hand. Moreover an ectopic branch originating from the anterior aspect of aorta must be distinguished from a right coronary artery with high takeoff.

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